

are substantially similar to counterparts of the basic embodiment of the vehicle mounted apparatus 20 depicted in FIG. 2 and described in detail above. Additionally, modified cordless range extension apparatus 540 may include accessories interfaced with transceiver 545 of handset 546, such as voice mail/answering machines, computers, video sources, etc.

FIG. 21 illustrates another modification 560 of the cordless range extension apparatus of FIG. 20. Modified cordless range extension apparatus 560 utilizes the cellular transceiver module or circuit board 561 of a portable cellular phone 530, but dispenses with the requirement for a microphone, earphone, and a key pad, since these may all be located in portable handset 546.

FIG. 22 shows another modification of the cordless range extension apparatus of FIG. 20. In modified cordless range extension apparatus 570, cellular phone transceiver module 561 may be placed in any desired location, such as within a briefcase 571.

FIG. 23 shows a prior art portable computer 580 coupled via a PCMCIA (Personal Computer Memory Card International Association) modem 581 and cellular transceiver board 561 by RF signals 532 and 533 to a cellular transceiver site 531. Cellular transceiver board 561 is provided with a switchable communication port 582, which allows audio voice communications from a headset for example, to interface with the cell site, in place of digital signals from computer 580.

FIG. 24 illustrates a modification 590 of the cordless range extension apparatus of FIG. 20, which utilizes elements of the apparatus shown in FIG. 23. Thus, as shown in FIG. 24 modified cordless range extension apparatus 590 includes a resident link transceiver 542 coupled to switchable communications port 582 of cellular transceiver board 561 through interface unit 541. Resident link transceiver 542 communicates, preferably by radio frequency signals, with a remote link transceiver 545 in handset 546. The structure and function of these latter elements are substantially similar to those of embodiment 540 shown in FIG. 20 and described above.

Switchable communication port 582 of cordless range extension apparatus 590 may include a manually operable electrical switch to alternatively connect either portable computer 580 or remote extension handset 546 to PCMCIA modem 581. Alternatively, selection of alternative devices to couple with PCMCIA modem 581 may be achieved by an electronic multiplex switch, actuated by command signals from computer 580 and/or keypad 552 of handset 546. The details of such mechanical or electronic switching are well-known to those skilled in the art, and need not be described here.

FIG. 25 illustrates a pen-based system adapted to interface with a cellular telephone network. Pen-based system 600 utilizes a hand-held pen-based data entry module 601, which stores in electronic memory strokes from key pad 601A and/or pen or stylus strokes made on a graphic entry pad 601B. Data entry module 601 is inserted into a cradle 602 that electronically interfaces with memory elements in the data entry module, allowing data stored therein to be transmitted via a cellular transceiver module 603 within the cradle to transmit the data to a cell site 531, and receive data from the cell site.

FIG. 26 illustrates a modification 610 of the cordless range extension apparatus of FIG. 20, which utilizes elements of the apparatus shown in FIG. 25. Thus, as shown in FIG. 26, modified cordless range extension apparatus 610

includes a resident link transceiver 542 coupled to a switchable communication port 612 operably interconnected with data entry module 601. Switchable communication port 612 may be used to manually or electronically select between remote handset 546 and pen-based data entry module 601 to communicate via cellular transceiver module 603 with cell site 531, in a manner exactly analogous to that described above for apparatus 590 shown in FIG. 24.

What is claimed is:

1. A cordless remote handset extension apparatus for cellular mobile telephones (CMT's) having a handset and a transceiver, said apparatus comprising:

a. adapter means interconnectable between said handset and said transceiver of said CMT, said adapter means including,

(i) down-link transmitter means having an output down-link carrier signal being non-interfering with operating frequencies of said CMT transceiver,

(ii) means for modulating said down-link carrier signal with CMT information signals received by said CMT transceiver,

(iii) up-link receiver means tunable to an up-link carrier signal modulated with up-link information signals, said up-link carrier signal being non-interfering with operating frequencies of said CMT transceiver,

(iv) means for modulating an RF carrier signal produced by said CMT transmitter with said up-link information signals,

(v) control circuitry means for converting up-link information signals received by said up-link receiver means to CMT interface data signals of the same format and protocol as corresponding signals produced by said CMT handset when said CMT handset is used to receive and initiate CMT calls, for converting CMT handset control signals emitted by said CMT transceiver to a modulation signal for said down-link carrier signal, for entering an extension control mode and producing a down-link dial tone signal when hailed by a properly coded up-link signal, for producing a down-link ringer signal upon receipt of a CMT ringer signal indicating receipt of an incoming CMT call, and entering an extension control mode upon receipt of a properly coded up-link off-hook signal, and

b. a remote cordless handset/transceiver unit physically isolated from said adapter means and including,

(i) an up-link transmitter having an output up-link carrier signal being non-interfering with operating frequencies of said CMT transceiver,

(ii) modulation means for modulating said up-link carrier signal,

(iii) down-link receiver means tunable to said down-link carrier signal, and

(iv) demodulation means for demodulating information signals on said down-link carrier.

2. The apparatus of claim 1 further including a microphone operably connected to said modulation means.

3. The apparatus of claim 2 further including a loudspeaker operably connected to said demodulation means.

4. An adapter affording a capability for utilizing a cordless remote handset/transceiver extension apparatus with cellular mobile telephones (CMT's) having a handset and a transceiver, said adapter being interconnectable between said handset and said transceiver of said CMT and comprising;

a. down-link transmitter means having an output down-link carrier signal being non-interfering with operating frequencies of said CMT transceiver,

- b. means for modulating said down-link carrier signal with CMT information signals received by said CMT transceiver,
  - c. up-link receiver means tunable to an up-link carrier signal modulated with up-link information signals, said up-link carrier signal being non-interfering with operating frequencies of said CMT transceiver,
  - d. means for modulating an RF carrier signal produced by said CMT transmitter with said up-link information signals, and
  - e. control circuitry means for converting up-link information signals received by said up-link receiver means to CMT interface data signals of the same format and protocol as corresponding signals produced by said CMT handset when said CMT handset is used to receive and initiate CMT calls, for converting CMT handset control signals emitted by said CMT transceiver to a modulation signal for said down-link carrier signal, for entering an extension control mode and producing a down-link dial tone signal when hailed by a properly coded up-link signal, for producing a down-link ringer signal upon receipt of a CMT ringer signal indicating receipt of an incoming CMT call, and entering an extension control mode upon receipt of a properly coded up-link off-hook signal.
5. An extension accessory apparatus for cellular mobile telephones (CMT's) having a handset and a transceiver, said apparatus comprising:
- a. an adapter means interconnectable to said handset and said transceiver, said adapter means including,
    - (i) first, resident low-power down-link transceiver means having (A) down-link transmitter of lower power output than that of the transmitter of said CMT transceiver, and an operating frequency different from those of both said CMT transmitter and the receiver of said CMT transceiver, (B) means for modulating a carrier signal produced by said down-link transmitter means with CMT information signals received by said CMT transceiver, (C) up-link receiver means for receiving an up-link carrier signal modulated with up-link information signals, said up-link carrier having a frequency different from those of said CMT transmitter and said down-link transmitter, and (D) means for modulating an RF

- carrier signal produced by said CMT transmitter with said up-link information signals,
- (ii) control circuitry means for converting received up-link data signals to CMT interface data signals of the same format as required by said CMT transceiver, and for converting CMT control signals emitted by said CMT transceiver to a modulation signal for said down-link carrier signal,
- b. a cordless handset/transceiver unit not connected by wires to said adapter means and including,
  - (i) a second, remote low-power up-link transceiver including (A) an up-link transmitter of lower power output than that of said CMT transmitter and an operating frequency different from those of both said CMT transmitter and said CMT receiver, (B) means for modulating a carrier signal produced by said up-link transmitter with up-link information signals, (C) signal input port means operably connected to said modulation means, (D) a down-link receiver which receives a down-link carrier signal from said down-link transmitter means, (E) means for demodulating information signals on said down-link carrier, and (F) signal output port means connected to said demodulator means for reproducing said demodulated down-link signals, whereby information signals received by said CMT transceiver may be relayed through said signal output port means, and information signals inputted to said signal input port means of said cordless handset/transceiver unit may be transmitted by said CMT transceiver, and
- c. a multiplex selector switch, said multiplex selector switch having an output port electrically coupled to a signal port of said CMT transceiver, a first input port electrically coupled to a signal port of said resident down-link transceiver, a second input port coupleable to a second signal port, and means for actuating said multiplex selector switch to alternatively couple said first or second input ports to said output port connected to said CMT transceiver.
- 6. The apparatus of claim 5 wherein said means for actuating said multiplex selector switch is further defined as being an electronic signal produced by said cordless handset/transceiver unit.

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--7. A cordless remote mobile unit extension apparatus connectable to a cellular mobile device (CMD) having a mobile unit and a transceiver, the apparatus comprising:

- a. an adapter interconnectable between the mobile unit and the transceiver of the CMD, the adapter including,
  - (i) a down-link transmitter having an output down-link carrier signal being non-interfering with operating frequencies of the CMD transceiver,
  - (ii) a down-link modulator configured to modulate the down-link carrier signal with CMD information signals received by the CMD transceiver,
  - (iii) an up-link receiver tunable to an up-link carrier signal modulated with up-link information signals, the up-link carrier signal being non-interfering with operating frequencies of the CMD transceiver,
  - (iv) a RF modulator configured to modulate an RF carrier signal produced by the CMD transmitter with the up-link information signals,
  - (v) control circuitry configured to convert up-link information signals received by the up-link receiver to CMD interface data signals of the same format and protocol as corresponding signals produced by the CMD mobile unit when the CMD mobile unit is used to receive and initiate CMD calls, to convert CMD mobile unit control signals emitted by the CMD transceiver to a modulation signal for the down-link carrier signal, to enter an extension control mode and produce a down-link dial tone signal when hailed by a properly coded up-link signal, to produce a down-link

ringer signal upon receipt of a CMD ringer signal indicating receipt of an incoming CMD call, and to enter an extension control mode upon receipt of a properly coded up-link off-hook signal, and

b. a remote cordless mobile unit/transceiver unit physically isolated from the adapter and including,

(i) an up-link transmitter having an output up-link carrier signal being non-interfering with operating frequencies of the CMD transceiver,

(ii) an up-link modulator configured to modulate the up-link carrier signal,

(iii) a down-link receiver tunable to the down-link carrier signal, and

(iv) a down-link demodulator configured to demodulate information signals on the down-link carrier signal.

8. The apparatus of claim 7 further including a microphone operably coupled to the up-link modulator.

9. The apparatus of claim 8 further including a loudspeaker operably coupled to the down-link demodulator.

10. The apparatus of claim 9 wherein the adapter is a cellular transceiver module modem.

11. The apparatus of claim 10 wherein the adapter is configured to be coupled to a computer or a pen based pad.

12. The apparatus of claim 10 wherein the adapter is configured to be coupled to a wireless telephone.

13. The apparatus of claim 9 wherein the remote cordless mobile unit/transceiver unit is an extension mobile headset.

14. The apparatus of claim 9 wherein the remote cordless mobile unit/transceiver unit is an extension mobile handset.

15. The apparatus of claim 7 wherein the remote cordless mobile unit/transceiver unit is a beeper/pager.

16. The apparatus of claim 9 wherein the remote cordless mobile unit/transceiver unit is a computer.

17. The apparatus of claim 9 wherein the remote cordless mobile unit/transceiver unit is a voice mail/answering machine unit.

18. The apparatus of claim 9 wherein the remote cordless mobile unit/transceiver unit is a video unit.

19. An adapter configured to communicate with a cordless remote mobile unit/transceiver extension apparatus coupled to a cellular mobile device (CMD's) having a mobile unit and a transceiver, the adapter being interconnectable between the mobile unit and the transceiver of the CMD and comprising:

- a. a down-link transmitter having an output down-link carrier signal being non-interfering with operating frequencies of the CMD transceiver,
- b. a modulator configured to modulate the down-link carrier signal with CMD information signals received by the CMD transceiver,
- c. an up-link receiver tunable to an up-link carrier signal modulated with up-link information signals, the up-link carrier signal being non-interfering with operating frequencies of the CMD transceiver,
- d. an RF modulator configured to modulate an RF carrier signal produced by the CMD transceiver with the up-link information signals, and
- e. control circuitry configured to convert up-link information signals received by the up-link receiver to CMD interface data signals of the same format and protocol as corresponding signals produced by the CMD mobile unit when the CMD mobile unit is used to receive and initiate CMD calls, configured to convert CMD mobile unit control signals emitted by the CMD transceiver to a modulation signal for the down-link carrier signal, configured to enter an extension control mode and producing a down-link dial tone signal when hailed by a properly coded up-link signal, configured to produce a down-link ringer signal upon receipt of a CMD ringer signal indicating receipt of an incoming CMD call, and configured to enter an extension control mode upon receipt of a properly coded up-link off-hook signal.

20. The apparatus of claim 19 wherein the adapter is a cellular transceiver module modem.

21. The apparatus of claim 19 wherein the adapter is configured to be coupled to a computer or a pen based pad.

22. The apparatus of claim 19 wherein the adapter is configured to be coupled to a wireless telephone.

23. An extension accessory apparatus connectable to a cellular mobile device (CMD's) having a mobile unit and a transceiver, the apparatus comprising:

a. an adapter interconnectable to the mobile unit and the transceiver, the adapter including,

(i) a first resident low-power down-link transceiver having

(A) a down-link transmitter of lower power output than that of the transmitter of the CMD transceiver, and an operating frequency different from those of both the CMD transmitter and a receiver of the CMD transceiver,

(B) a first carrier signal modulator configured to modulate a carrier signal produced by the down-link transmitter with CMD information signals received by the CMD transceiver,

(C) an up-link receiver configured to receive an up-link carrier signal modulated with up-link information signals, the up-link carrier having a frequency different from those of the CMD transmitter and the down-link transmitter, and

(D) an RF modulator configured to modulate an RF carrier signal produced by the CMD transmitter with the up-link information signals,

- (ii) control circuitry configured to convert received up-link data signals to CMD interface data signals of the same format as required by the CMD transceiver, and configured to convert CMD control signals emitted by the CMD transceiver to a modulation signal for the down-link carrier signal,
- b. a cordless mobile unit/transceiver unit not connected by wires to the adapter and including,
  - (i) a second remote low-power up-link transceiver including
    - (A) an up-link transmitter of lower power output than that of the CMD transmitter and an operating frequency different from those of both the CMD transmitter and the CMD receiver,
    - (B) a second carrier signal modulator configured to modulate a carrier signal produced by the up-link transmitter with up-link information signals,
    - (C) signal input port operably coupled to the second carrier signal modulator,
    - (D) a down-link receiver configured to receive a down-link carrier signal from the down-link transmitter,
    - (E) a down-link demodulator configured to demodulate information signals on the down-link carrier, and
    - (F) a signal output port coupled to the down-link demodulator configured to reproduce the demodulated down-link signals, whereby information signals received by the CMD transceiver may be relayed through the signal output port, and information signals input to the signal input port



of the cordless mobile unit/transceiver unit may be transmitted by the CMD transceiver, and

c. a multiplex selector switch, the multiplex selector switch having an output port electrically coupled to a signal port of the CMD transceiver, a first input port electrically coupled to a signal port of the resident down-link transceiver, a second input port coupleable to a second signal port, and an actuator configured to actuate the multiplex selector switch to alternatively couple the first or second input ports to the output port coupled to the CMD transceiver.

24. The apparatus of claim 23 wherein the actuator is an electronic signal produced by the cordless mobile unit/transceiver unit.

25. The apparatus of claim 24 wherein the adapter is a cellular transceiver module modem.

26. The apparatus of claim 25 wherein the adapter is configured to be coupled to a computer or a pen based pad.

27. The apparatus of claim 25 wherein the adapter is configured to be coupled to a wireless telephone.

28. The apparatus of claim 25 wherein the remote cordless mobile unit/transceiver unit is an extension mobile headset.

29. The apparatus of claim 25 wherein the remote cordless mobile unit/transceiver unit is an extension mobile handset.

30. The apparatus of claim 25 wherein the remote cordless mobile unit/transceiver unit is a beeper/pager.

31. The apparatus of claim 25 wherein the remote cordless mobile unit/transceiver unit is a computer.

32. The apparatus of claim 25 wherein the remote cordless mobile unit/transceiver unit is a voice mail/answering machine unit.

33. The apparatus of claim 25 wherein the remote cordless mobile unit/transceiver unit is a video unit --

34. A cordless mobile unit/transceiver unit not connected by wires to a cellular mobile device (CMD's) having a mobile unit and a transceiver, the apparatus comprising:  
an up-link transmitter having an output up-link carrier signal being non-  
interfering with operating frequencies of a CMD transceiver,  
an up-link modulator configured to modulate the output up-link carrier signal,  
a down-link receiver tunable to a down-link carrier signal, and  
a down-link demodulator configured to demodulate information signals on a  
down-link carrier signal.

35. The apparatus of claim 34 further including a microphone operably coupled to the up-link modulator.

36. The apparatus of claim 36 further including a loudspeaker operably coupled to the down-link demodulator.

37. The apparatus of claim 34 wherein the cellular mobile device is a cellular transceiver module modem.

38. The apparatus of claim 34 wherein the cellular mobile device is a computer or a pen based pad.

39. The apparatus of claim 34 wherein the cellular mobile device is a wireless telephone.

40. A cordless remote extension apparatus connectable to a cellular mobile device (CMD), the apparatus comprising:

a. an adapter interconnectable to the CMD, the adapter including,

(i) a down-link transmitter having an output down-link carrier signal being non-interfering with operating frequencies of the CMD,

(ii) a down-link modulator configured to modulate the down-link carrier signal with CMD information signals received by the CMD,

(iii) an up-link receiver tunable to an up-link carrier signal modulated with up-link information signals, the up-link carrier signal being non-interfering with operating frequencies of the CMD,

(iv) control circuitry configured to convert up-link information signals received by the up-link receiver to CMD interface data signals of

the same format and protocol as corresponding signals produced by the CMD, to convert CMD mobile unit control signals emitted by the CMD to a modulation signal for the down-link carrier signal, to enter an extension control mode and produce a down-link dial tone signal when hailed by a properly coded up-link signal, to produce a down-link ringer signal upon receipt of a CMD ringer signal indicating receipt of an incoming CMD call, and to enter an extension control mode upon receipt of a properly coded up-link off-hook signal, and

b. a remote cordless transceiver physically isolated from the adapter and including,

- (i) an up-link transmitter having an output up-link carrier signal being non-interfering with operating frequencies of the CMD,
- (ii) an up-link modulator configured to modulate the up-link carrier signal,
- (iii) a down-link receiver tunable to the down-link carrier signal, and
- (iv) a down-link demodulator configured to demodulate information signals on the down-link carrier signal.

41. The apparatus of claim 41 further including a microphone operably coupled to the up-link modulator.

42. The apparatus of claim 42 further including a loudspeaker operably coupled to the down-link demodulator.

43. The apparatus of claim 43 wherein the adapter is a cellular transceiver module modem.

44. The apparatus of claim 44 wherein the adapter is configured to be coupled to a computer or a pen based pad.

45. The apparatus of claim 44 wherein the adapter is configured to be coupled to a wireless telephone.

46. The apparatus of claim 43 wherein the remote cordless transceiver is an extension mobile headset.

47. The apparatus of claim 43 wherein the remote cordless transceiver is an extension mobile handset.

48. The apparatus of claim 41 wherein the remote cordless transceiver is a beeper/pager.

49. The apparatus of claim 43 wherein the remote cordless transceiver is a computer.

50. The apparatus of claim 43 wherein the remote cordless transceiver is a voice mail/answering machine unit.

51. The apparatus of claim 43 wherein the remote cordless transceiver is a video unit.

52. An adapter configured to communicate with a cordless remote extension apparatus coupled to a cellular mobile device (CMD), the adapter being connectable to the CMD, comprising:

a down-link transmitter having an output down-link carrier signal being non-interfering with operating frequencies of the CMD,

a modulator configured to modulate the down-link carrier signal with CMD information signals received by the CMD,

an up-link receiver tunable to an up-link carrier signal modulated with up-link information signals, the up-link carrier signal being non-interfering with operating frequencies of the CMD,

control circuitry configured to convert up-link information signals received by the up-link receiver to CMD interface data signals of the same format and protocol as corresponding signals produced by the CMD, configured to convert CMD control signals to a modulation signal for the down-link carrier signal, configured to enter an extension control mode and producing a down-link dial tone signal, configured to produce a down-link ringer signal, and configured to enter an extension control mode.

53. The adapter of claim 53 wherein the adapter is a cellular transceiver module modem.

54. The adapter of claim 53 wherein the adapter is configured to be coupled to a computer or a pen based pad.

55. The adapter of claim 53 wherein the adapter is configured to be coupled to a wireless telephone.

56. A cordless transceiver unit not connected by wires to a cellular mobile device (CMD), the apparatus comprising:

an up-link transmitter having an output up-link carrier signal being non-interfering with operating frequencies of a CMD,  
an up-link modulator configured to modulate the output up-link carrier signal,  
a down-link receiver tunable to a down-link carrier signal, and  
a down-link demodulator configured to demodulate information signals on a down-link carrier signal.

57. The apparatus of claim 57 further including a microphone operably coupled to the up-link modulator.

58. The apparatus of claim 58 further including a loudspeaker operably coupled to the down-link demodulator.

59. The apparatus of claim 57 wherein the cellular mobile device is a cellular transceiver module modem.

60. The apparatus of claim 57 wherein the cellular mobile device is a computer or a pen based pad.

61. The apparatus of claim 57 wherein the cellular mobile device is a wireless telephone.--